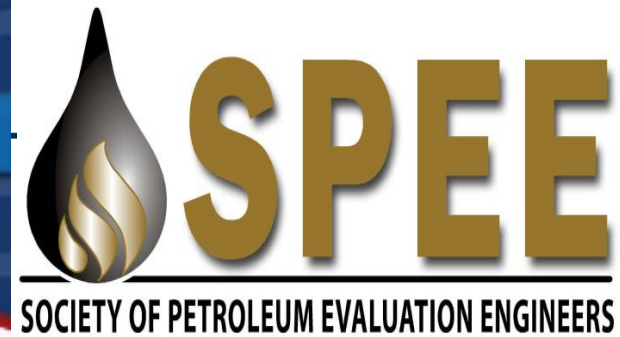




Society of Petroleum Engineers
London Section



Reserves and Portfolio Management : A Language that Communicates to the Investment Community

Investor's view of reserves & resources reporting, Part 2



Gavin Ward, FCCA, MBA, DipM, TPG, B.Sc (Hons)

RISC Advisory



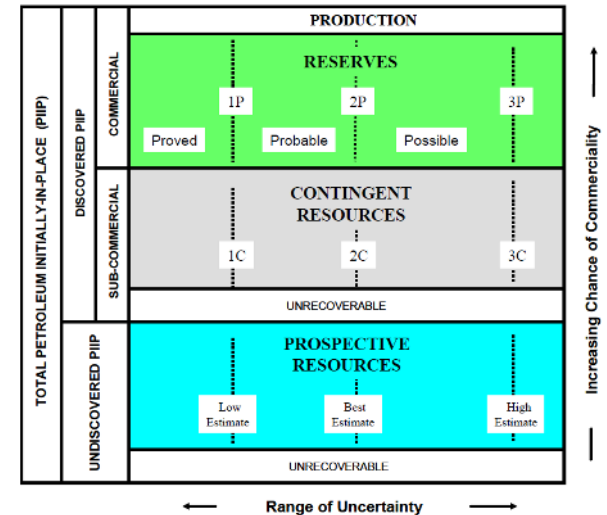
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- Framing the ‘Good, Bad & Ugly’ of Valuations
- Stock Portfolios Vs E&P Portfolios
- Estimating
 - Problems & impact
- Probabilistic Vs Deterministic
 - Aggregation & Theory of Inevitable Disappointment
- Outcomes & Calibration
 - Real portfolios & examples



FRAMING

With a few differences in detail, we can view & value a Portfolio of Upstream assets the same way we view & value a personal investment portfolio:



Decision Makers



Grey Area

$$2 + 2 = 4$$



$$2 + 2 + a = x$$



$$2 - 2 = 4$$



- Requires management to steer towards required outcome
- Poor estimating
- Wrong decision tools

Economic Limits – Good, Bad and Ugly

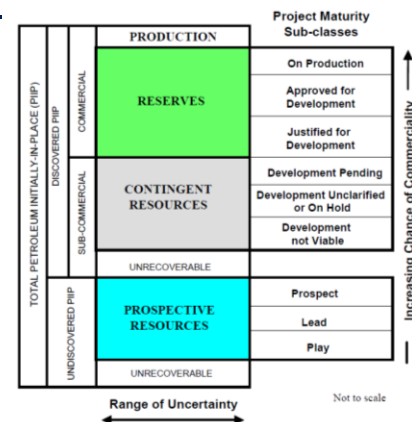
The Good : Economic Limit testing is a useful tool to indicate when net operating cash flow is no longer positive, and hence constrain future production forecasts/revenue to the ‘economic’ volumes. PRMS states:

- *Economic limit is defined as the production rate beyond which the net operating cash flows from a project, which may be an individual well, lease, or entire field, are negative, a point in time that defines the project’s economic life.*

The Bad : Economic limits may not necessarily be consistent with commercial decision making or optimizing targets under specific fiscal regimes as they ignore abandonment costs and income tax liabilities, even though these are real and often material cash outflows.

The Ugly : An operator may choose to produce for some time after economic limit:

- if it considers future prices will enable a return to positive cash flow.
- if it intends further development or remedial actions to increase production.
- Estimating
- Forecasting
- Decision Making
- Subjectivity & Data/Information



- PRMS guidelines do not require that project financing be confirmed prior to classifying projects as Reserves.
- In many cases, loans are conditional upon the project being economic based on Proved (1P) Reserves only : Reserves Based Lending (RBL).
- If financing is reasonably expected, but not yet confirmed, and financing is an external requirement for reporting in that jurisdiction, the project may be internally classified as Reserves (Justified for Development), but no Proved Reserves may be reported.
- If there is not a reasonable expectation that loans or other forms of financing (e.g., farm-outs) can be arranged such that the development will be initiated within a reasonable time frame, then the project should be classified as Contingent Resources.

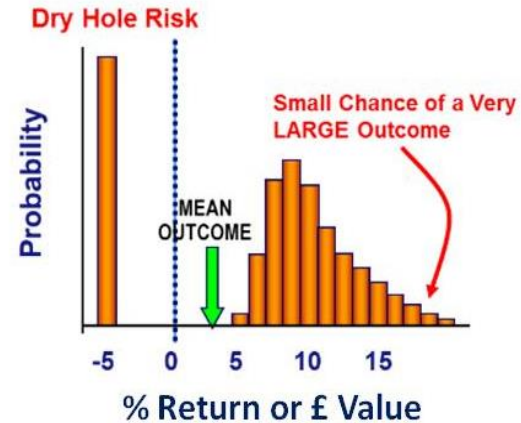
PORTFOLIOS

E&P projects versus stock market returns



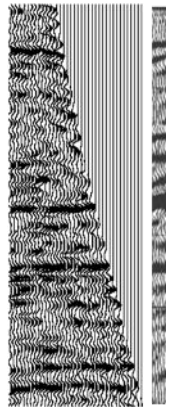
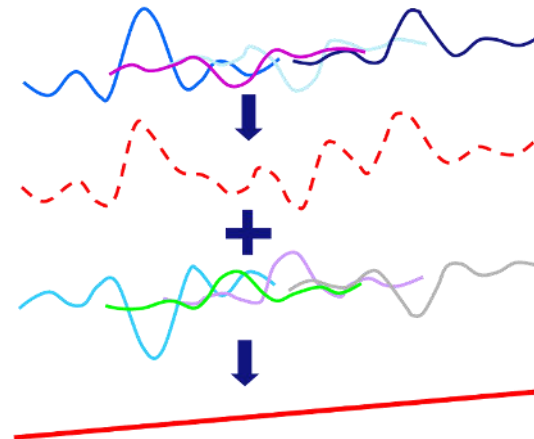
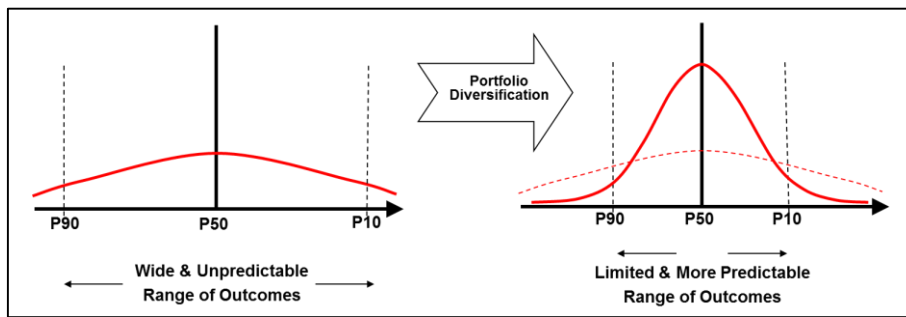
- Normal
- Main Risk is *Volatility*

Exploration Project



- Lognormal
- Risk of *Total Loss*

Portfolio Effect of predictability of multiple prospects/projects

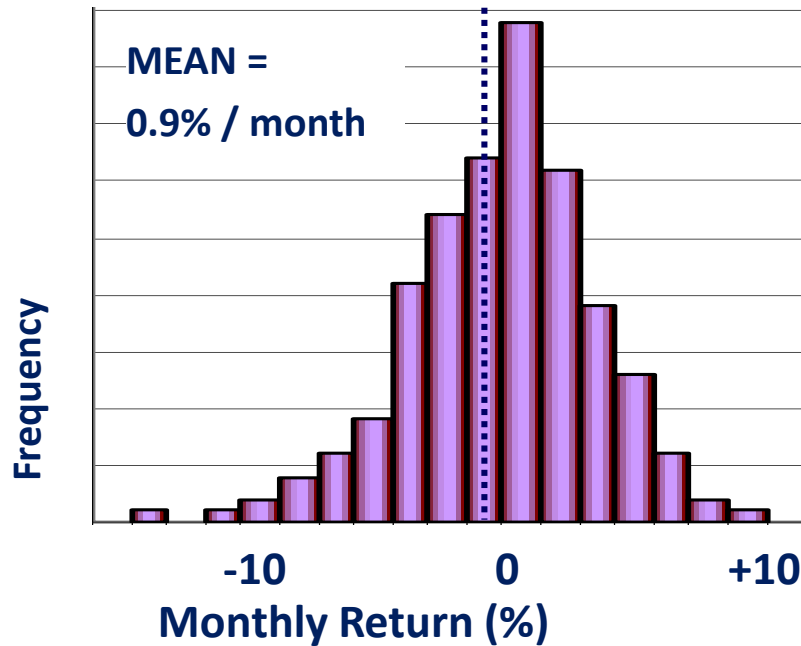


Stock Portfolios Vs E&P Portfolios

E&P is Driven by Unusual Events

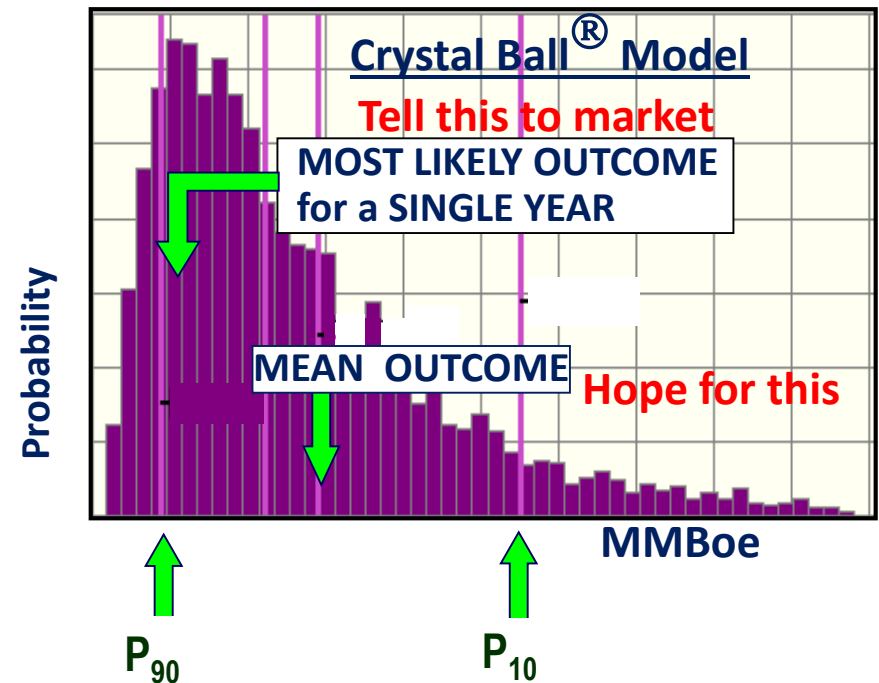
Balanced Stock Portfolios

S&P 500 Index, 1987-2005



Finite E&P Portfolios

NYSE Expl. Portfolio



LEHMAN BROTHERS

Equity Research

Oil & Gas: E&P

Thomas R. Driscoll, CFA • 212-526-3557



We believe that Newfield's plan to acquire \$575 million of Rocky Mountain assets from Stone Energy will have a neutral impact on NFX's share price in near term trading.

Newfield has struggled to grow production -- its large GOM asset base and execution issues have perhaps encouraged it to re-deploy capital into lower-risk regions. The Pinedale and Jonah Field assets are *very high quality* assets with strong drilling economics (assuming that current weak Rocky Mountain prices recover).

- The transaction should help to **improve the overall quality and predictability** of Newfield's asset base and lengthen its reserve life from 8.1 to 8.3 years (using pro-forma year end 2006 reserves divided by 2008E production).



"Driscoll, Thomas"
<Driscoll;
Thomas@research.lehman
.com

To: GWard
cc:
bcc:

ESTIMATING

Separated by a Common Language

Question: *When does $2 + 2 = 5$?*

Answer:

When Excel decimal places = 0

$$2.4 + 2.4 = 4.8 \quad \rightarrow \quad 2 + 2 = 5$$



Engineer risk = 36.47%



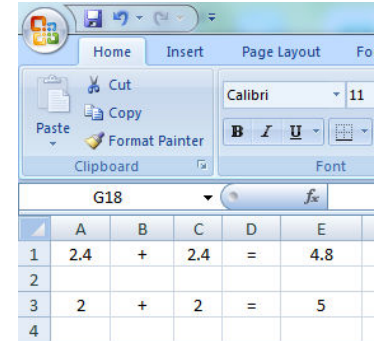
Economist risk = 0.365



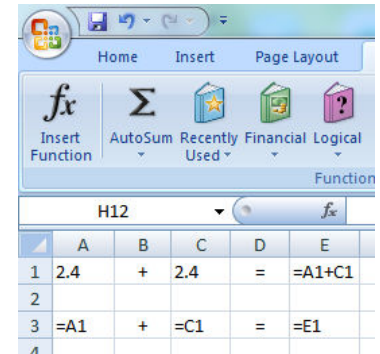
Geologist risk = 35%



Finance manager = £ which number ?



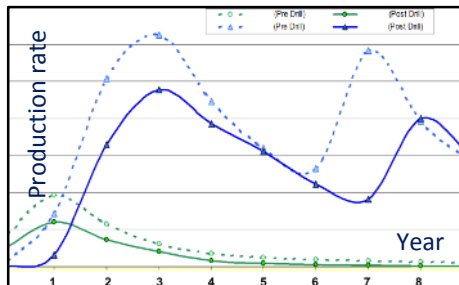
	A	B	C	D	E
1	2.4	+	2.4	=	4.8
2					
3	2	+	2	=	5
4					



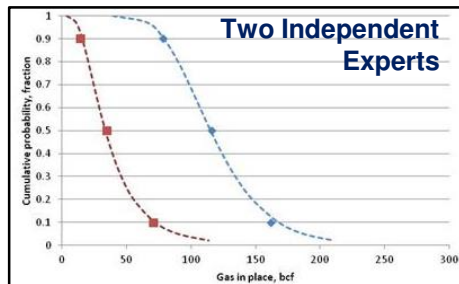
	A	B	C	D	E
1	2.4	+	2.4	=	=A1+C1
2					
3	=A1	+	=C1	=	=E1
4					

Poor Subsurface & Surface Estimating

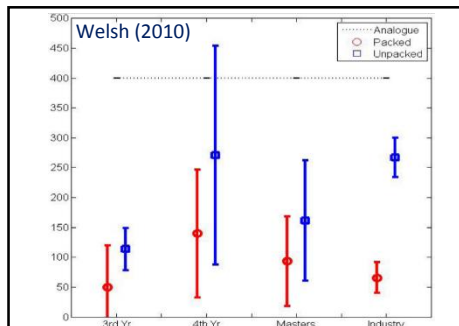
Exploration Optimism



Expert Complacency

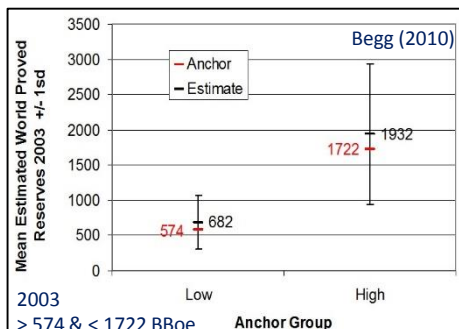


Complexity & Complacency

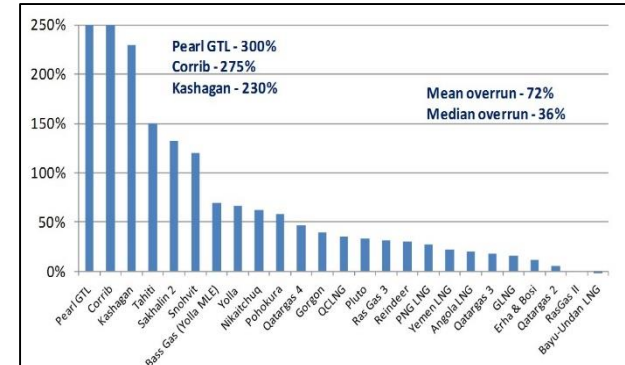


Anchoring

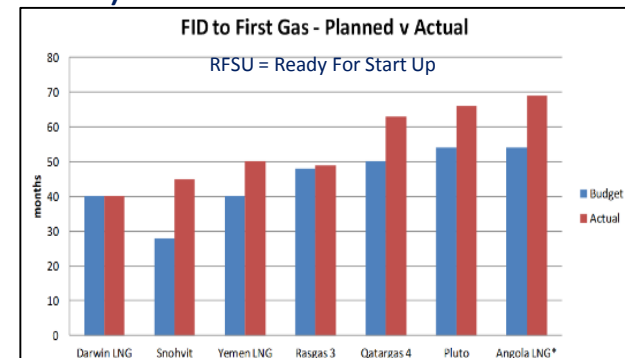
If information 'unpacked' uncertainty is recognized better



E&P Project Cost Overruns: 25 major projects since year 2000



FID to RFSU Avg. Overrun : 10 months (23%) 1 project (Darwin LNG) came in on schedule

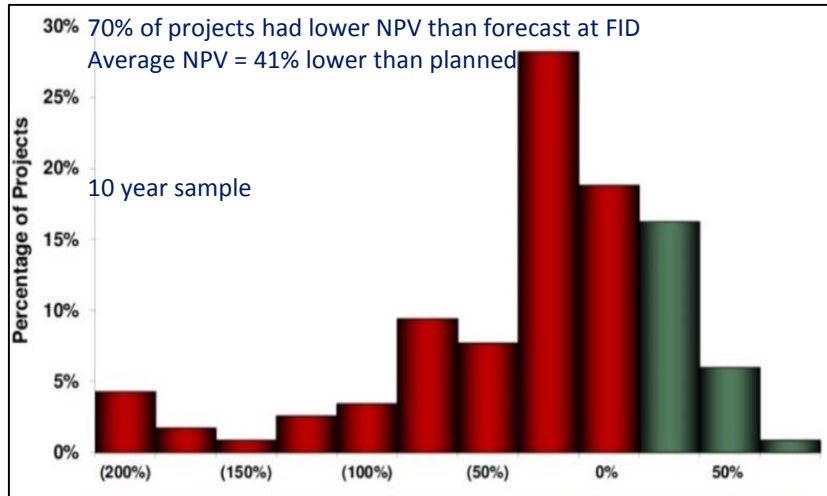


Targeted FID date to actual FID date for ten Australian LNG projects

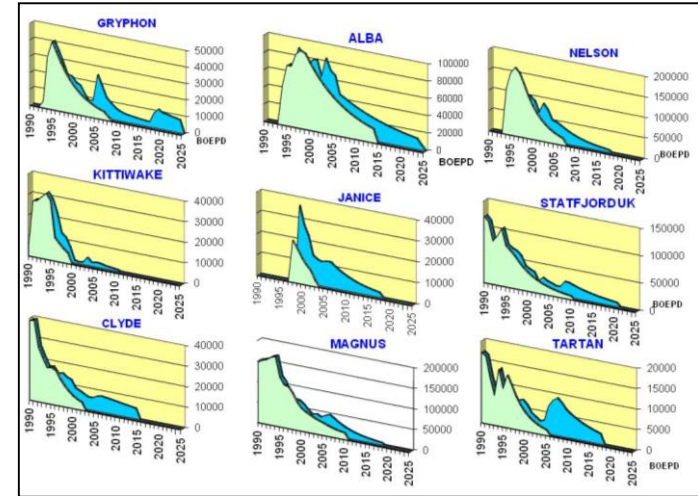
Project	Operator	Target FID	Actual FID
Pluto 1	Woodside	2007	August 2007
Gorgon 1-3	Chevron/Exxon/Shell	2004/2008	September 2009
QC LNG	BG Group	Early 2010	November 2010
GLNG	Santos/Petronas	Mid 2010	January 2011
APLNG (Train 1)	Origin/CoP	End 2010	July 2011
Wheatstone	Chevron	End 2011	September 2011
Ichthys	Inpex/Total	End 2010	January 2012
APLNG (Train 2)	Origin/CoP	End 2011 to Early 2012	July 2012
Browse		Mid 2012	TBA

Impact of Poor Estimating

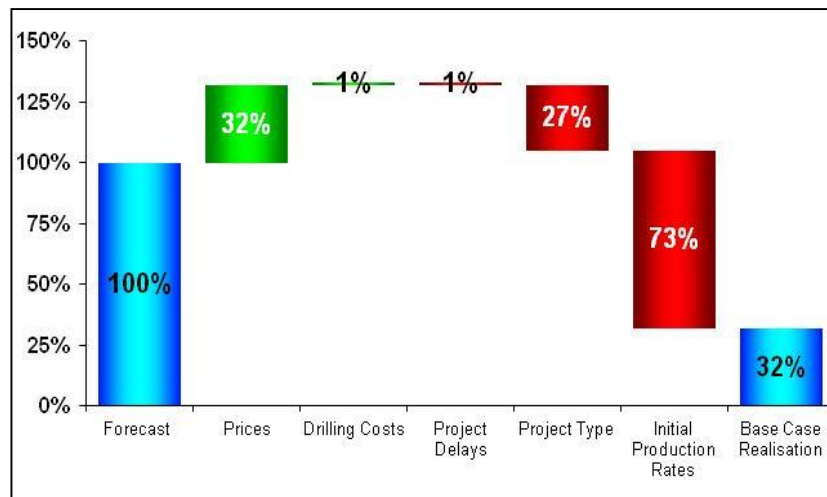
NPV gained (or lost) after two years of production relative to plan at sanction



North Sea Oil Production 1996 v 2006
Value gained after ten years of production relative to plan at sanction



Reasons for NPV loss of 60 well programme



- 1) Poor estimate of inputs
- 2) Inappropriate project 'shaping' i.e. wrong development for the resource
- 3) Confusing accuracy with confidence as information increases
- 4) Believing sophistication reduces risk
- 5) Under-estimation of time to complete tasks
- 6) Scope changes: poor definition, lack of rigor in approval process
- 7) Ignoring dependencies and inter-dependencies
- 8) Poor risk management: Lack of contingency, ineffectual contractual protection

Understand Distributions & Tools

PROBABILISTIC Vs DETERMINISTIC

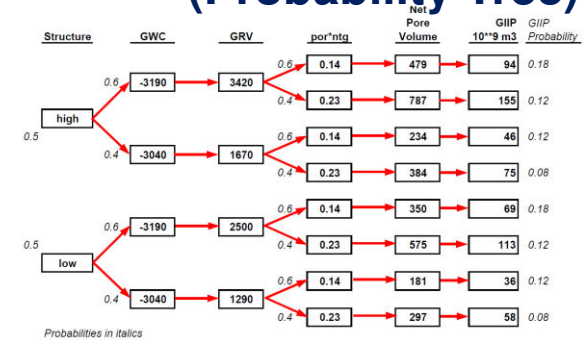
Aggregation of Reserves

PRMS 2011 “....If we stick to arithmetic aggregation of Proved Reserves, we run the risk of systematically underestimating the value of the combined assets..... this can be avoided (with probabilistic tools & methods).....”

Understanding range of Uncertainty:

- 1) Deterministic
- 2) Scenario Method
- 3) Probabilistic Method

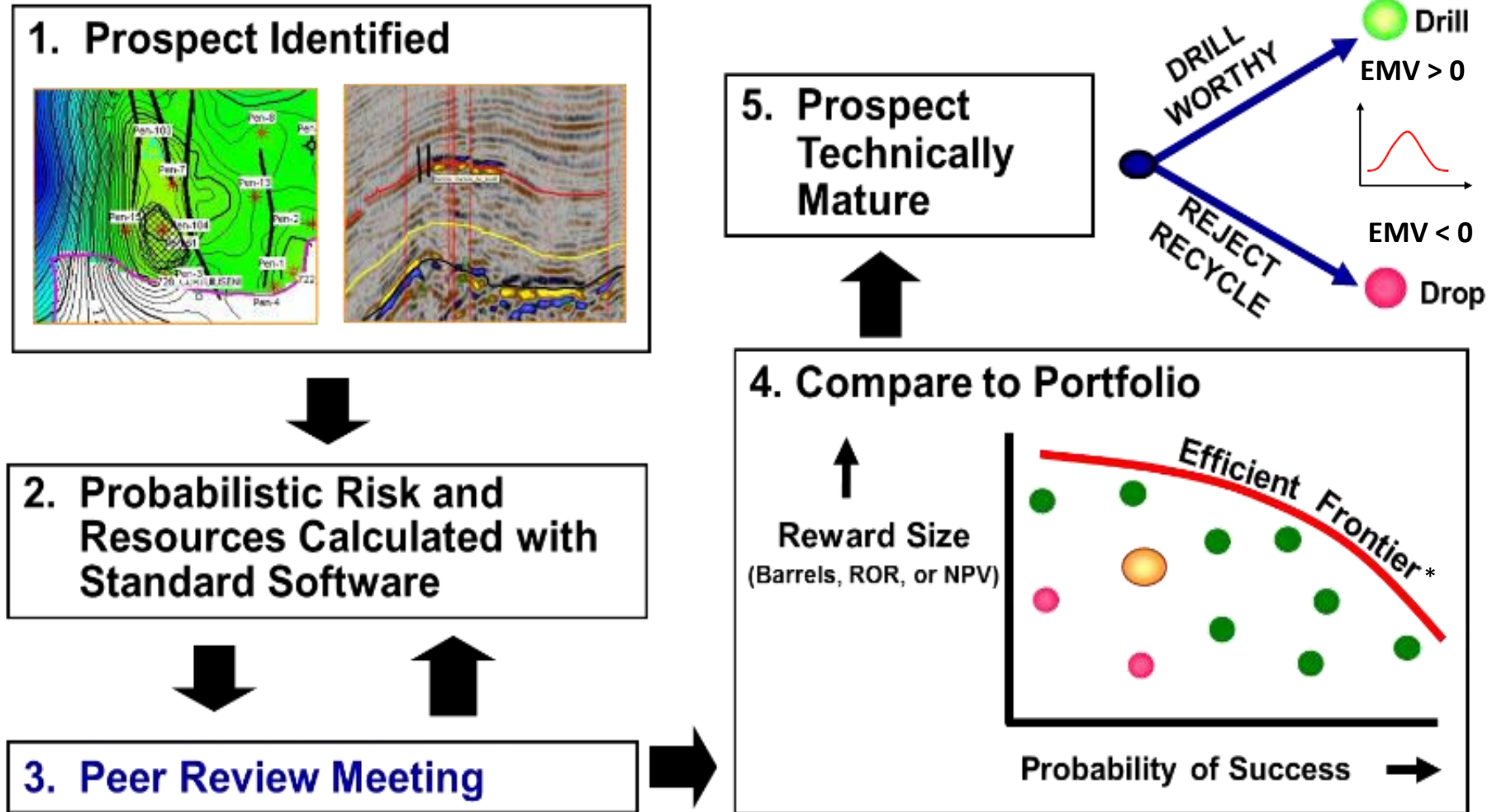
Deterministic Scenario method (Probability Tree)



PRMS 2011 “....Oil companies, considering long-term performance of assets....work on the assumption that in the long run, the portfolio of their best estimates will be realized, with the downside in one case compensated for by the upside in another situation.....**best practice** that*where assessments are based on deterministic methods, summations are arithmetic and by category.*

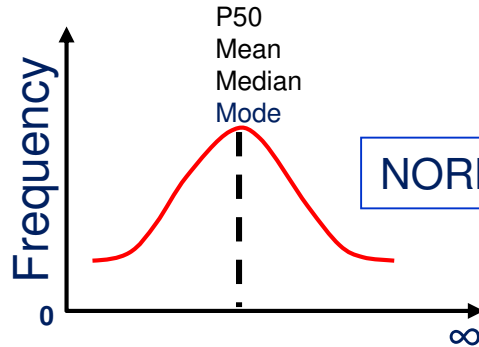
Where probabilistic assessments are available, companies may aggregate probabilistically to the field/project level but subsequent summations are generally arithmetic.....for internal portfolio analyses, companies may use fully probabilistic methods.....”

Portfolio Theory v Reality (**Deterministic** & Probabilistic)

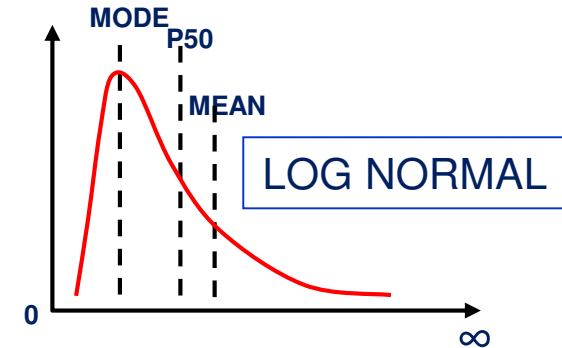


*Markowitz (1959)

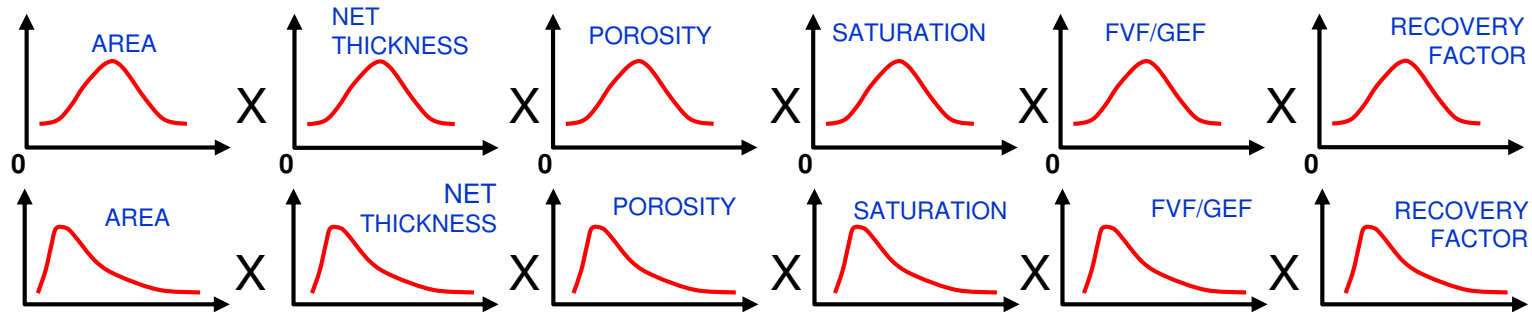
Hydrocarbon Resource Distributions are typically Log Normal



So what goes into EMV calculation?



Central Limit Theorem

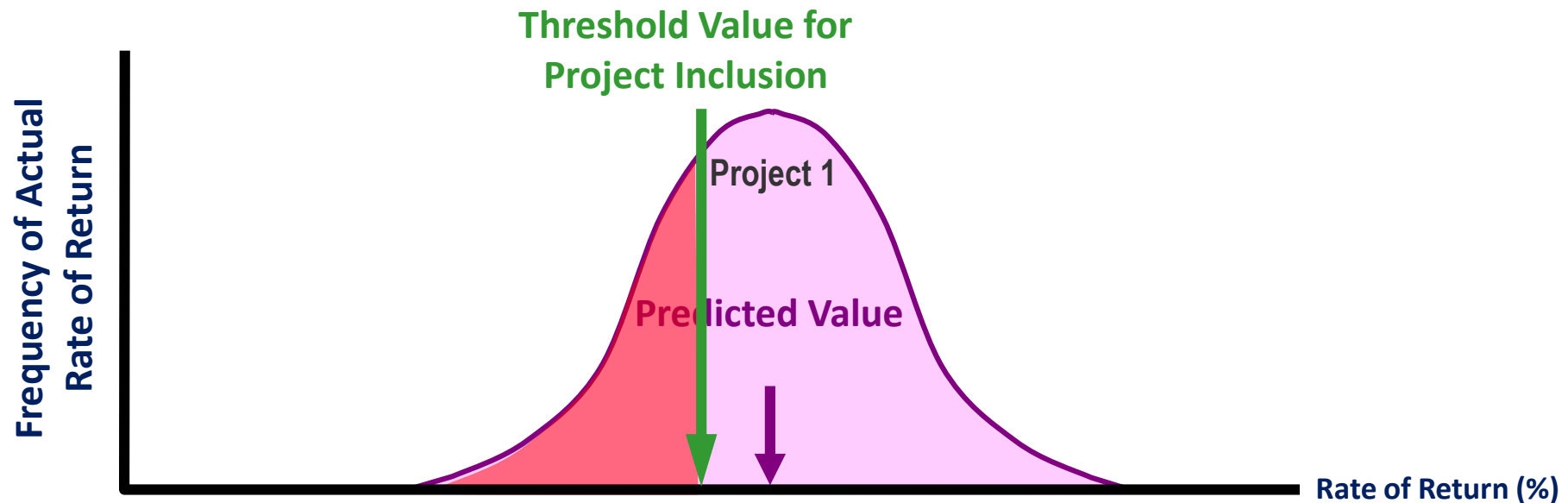


- **EMV** = (Chance of Success x NPV) – (Chance of Failure x Cost of Failure)
- **EMV** is a good tool but not understood
- 'Estimated' or 'Expected' = Most Likely = Mode
- Used as hurdle to accept/reject BUT used incorrectly most of time : WHY?
- Decisions need to understand whole distribution, not just one point
- Theory of Inevitable Disappointment (Horner, 1982) highlights inadequacy of using EMV and not considering whole distribution

Theory of Inevitable Disappointment

Actual performance of portfolio of assets will inevitably be worse than predicted

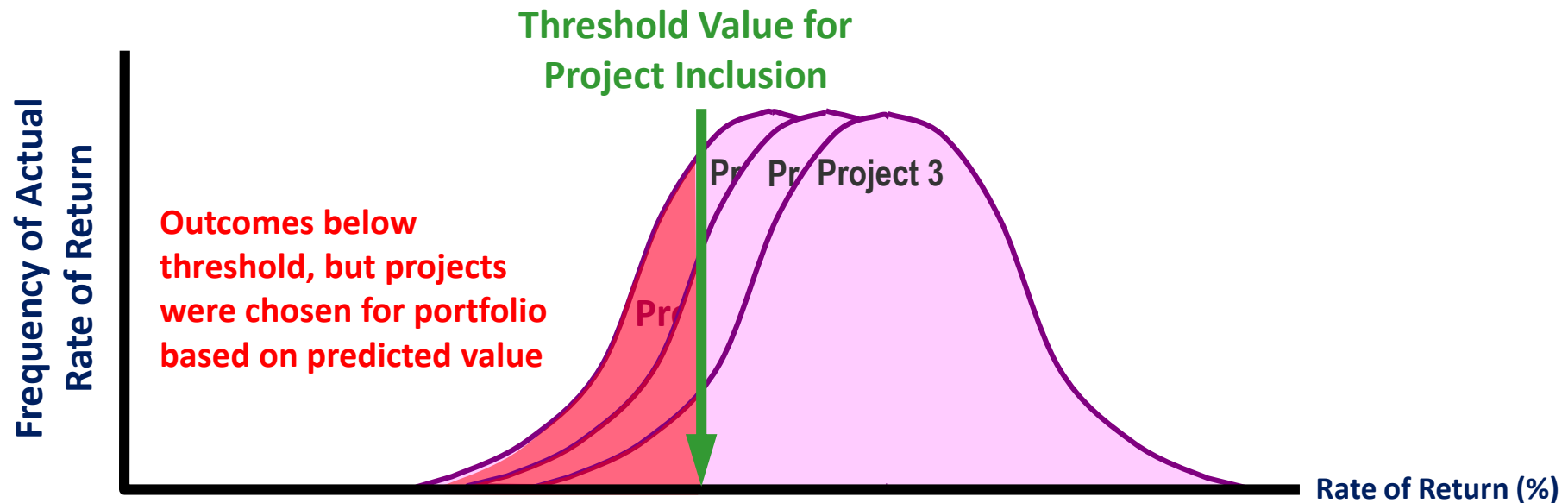
- Assume perfectly unbiased prediction with dispersion
- Projects chosen for investment in portfolio based on predicted or expected value

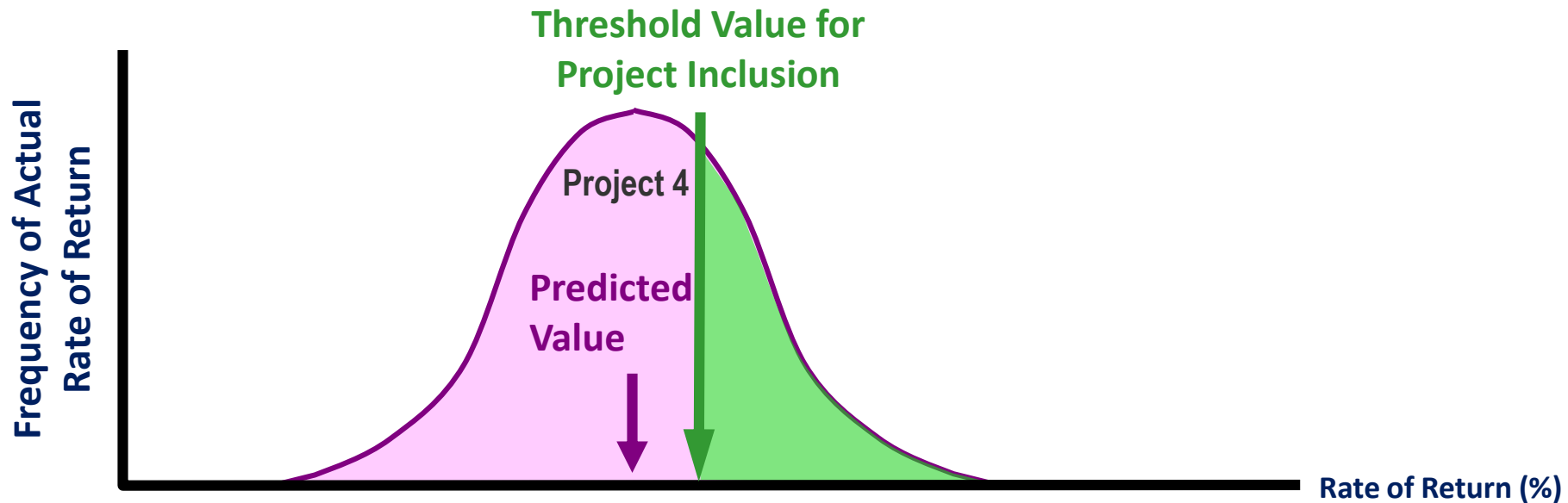


Theory of Inevitable Disappointment

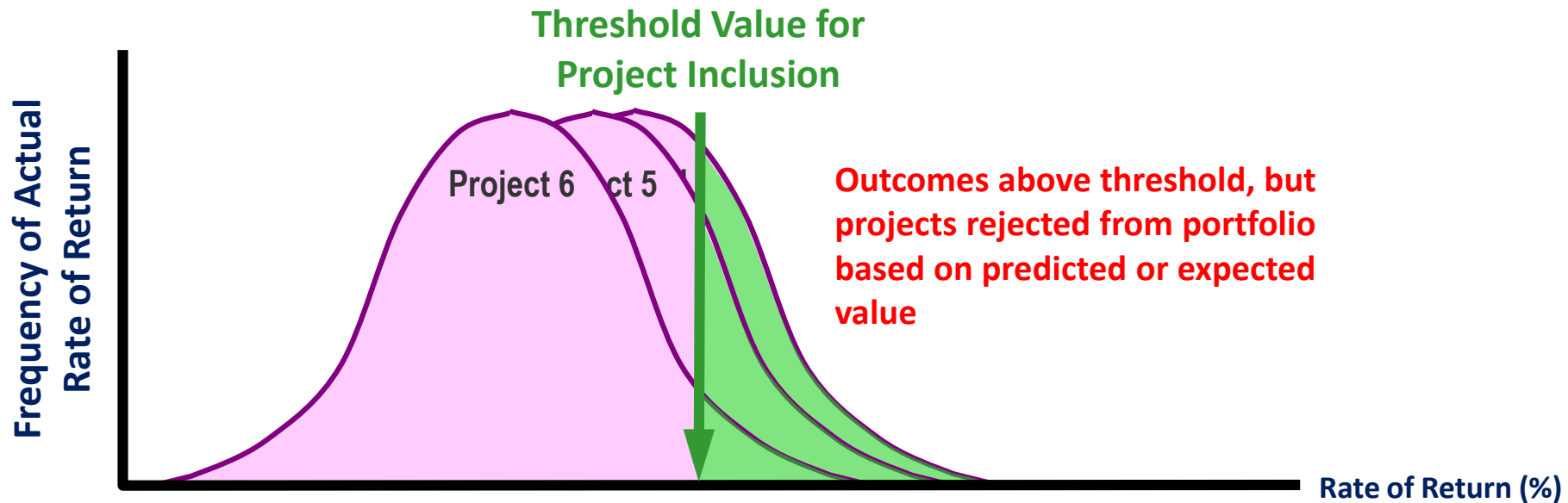
Actual performance of portfolio of assets will inevitably be worse than predicted

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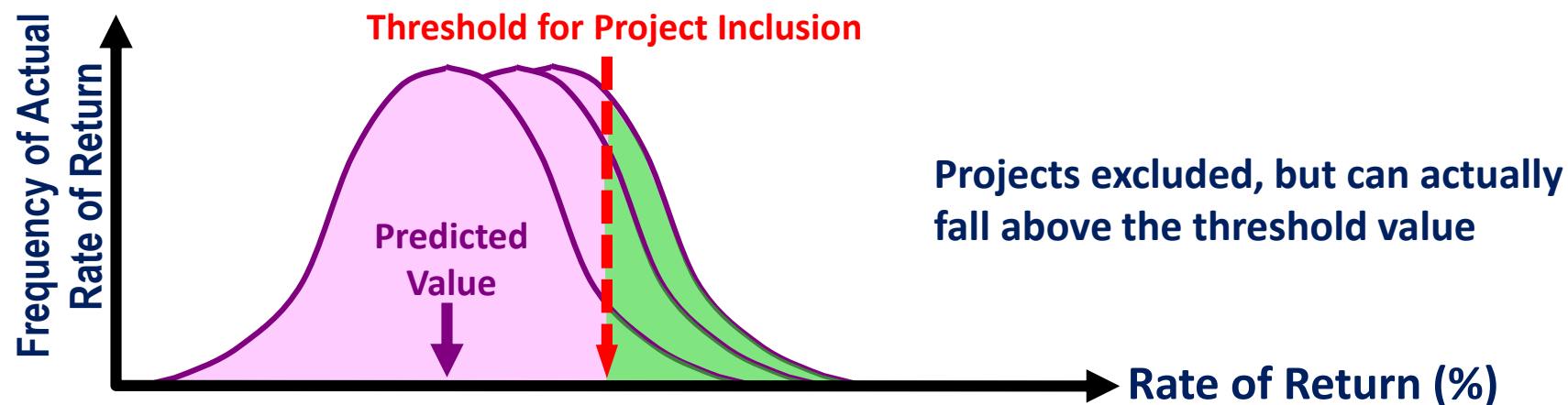
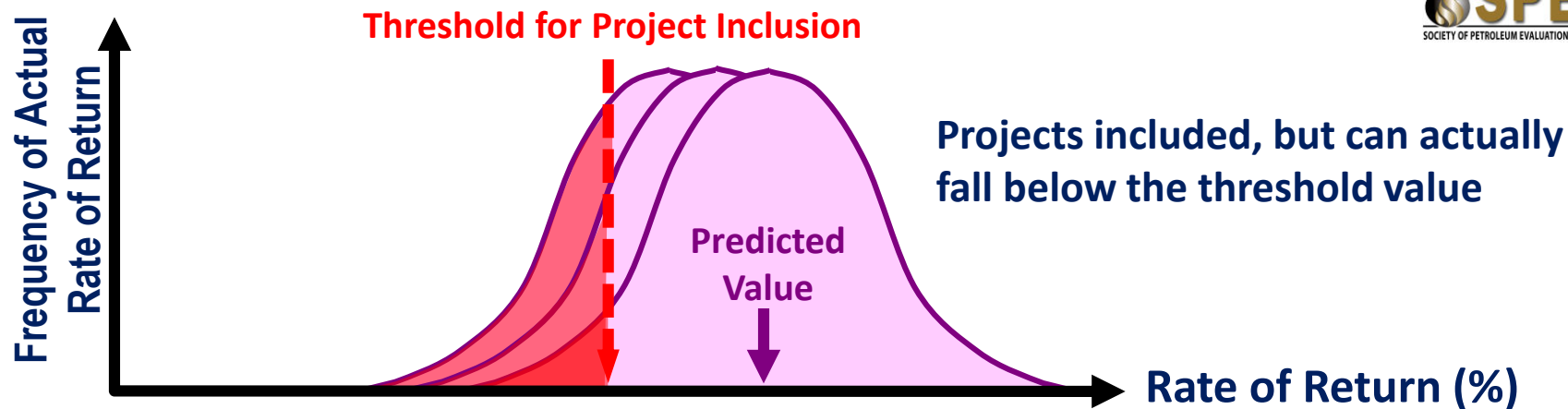


- Equally there will be portfolio outcomes above the '*company hurdle rate*'/threshold



- Equally there will be portfolio outcomes above the '*company hurdle rate*'/threshold

Modelling of 255 'Normal' projects



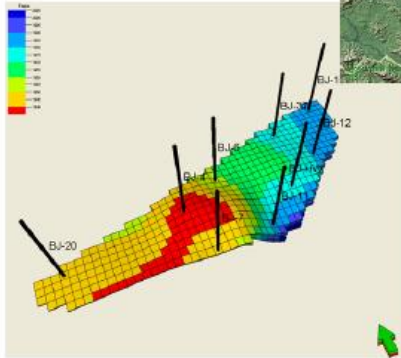
Portfolio predicted Rate of Return = 27%

Actual outcome Rate of Return = 18%

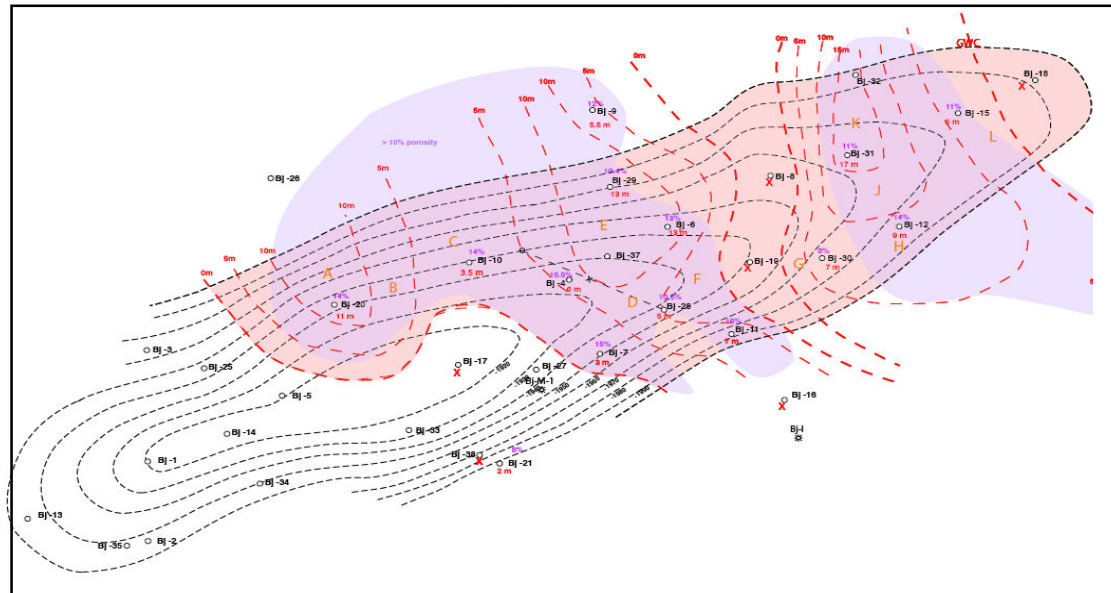
OUTCOMES & CALIBRATION

AIM Listed Company : Field Valuation

Bajcsa gas field, Hungary

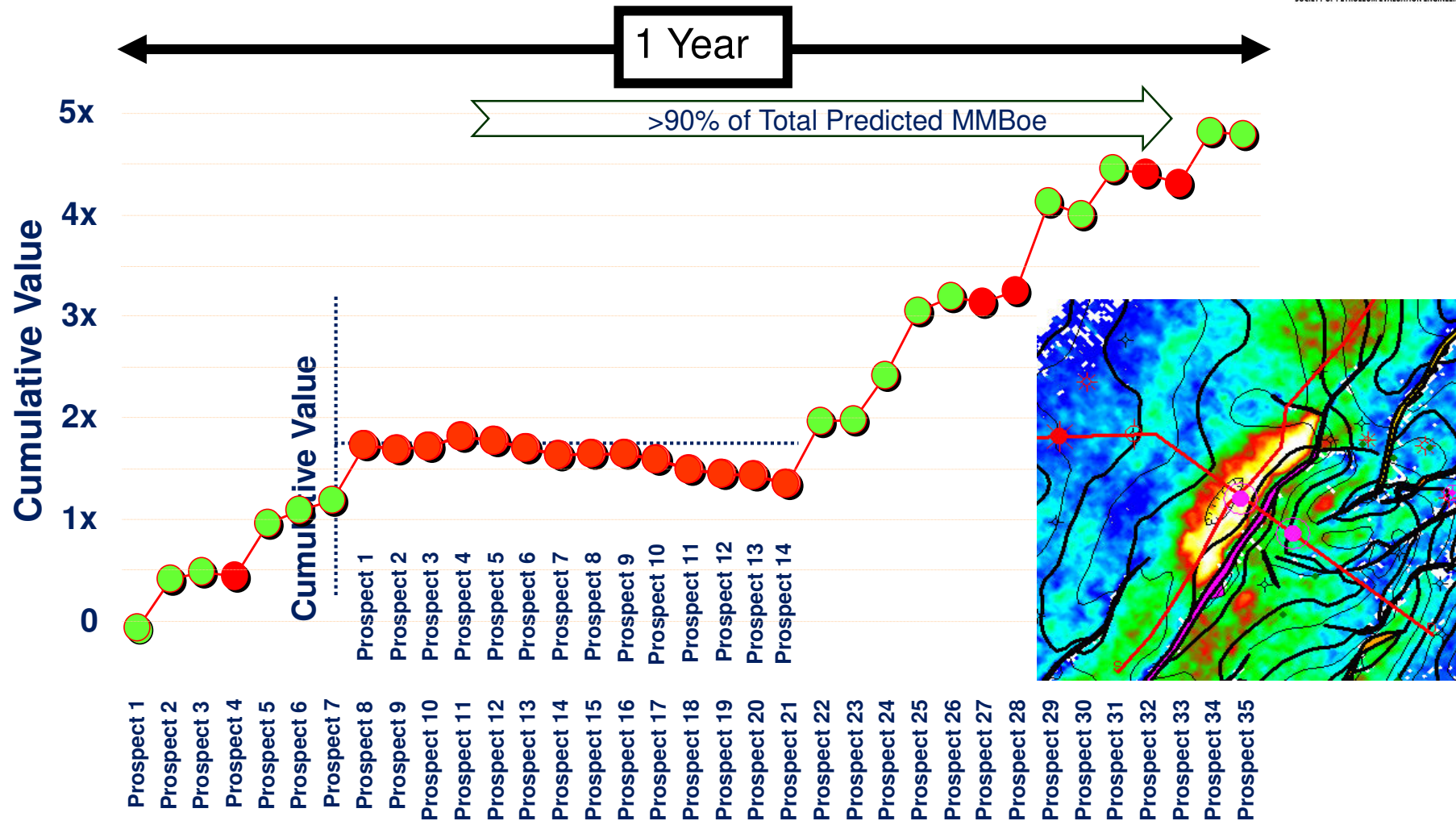


- RBL @ 1P (Proved)
- 2P Development Capital
- Focus Vs 'All eggs in one basket'
- Diversified Vs Unfocussed



NYSE Listed : Exploration Valuation

Onshore, Gulf of Mexico, USA



- Whilst Economic limits are a common industry metric, PRMS defines the limit in cash flow terms rather than value terms
- Production beyond the economic limit does not necessarily imply reclassifying of reserves under the PRMS, although.....
- ...‘Short period of low pricing’ and ‘reasonable price forecasts’ to justify ongoing production below the Economic Limit are unclear

RISC has evaluated hundreds subsurface (reserves and resources) & surface (costs and schedule) projects over twenty years.

- Same mistakes keep being made and repeated – We learn but also forget
- Recognise “black swan” events & make allowance with contingency
- Be wary of over confidence & experts: use genuinely independent peer reviewers
- Be aware of culture of many organisations that suppresses uncertainty & reward behaviour that ignores it (e.g. an executive who shows greater confidence in a plan is more likely to get it approved than one who lays out all the risks and uncertainties)
- Learn from previous experience (feedback/post-mortems), **calibration is KING**

Thank you to my current & former colleagues for their contributions:

Geoff Salter, Geoff Barker, Simon Whitaker & Henry Pettingill

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decisions with confidence

